U. S. DEPARTMENT OF AGRICULTURE

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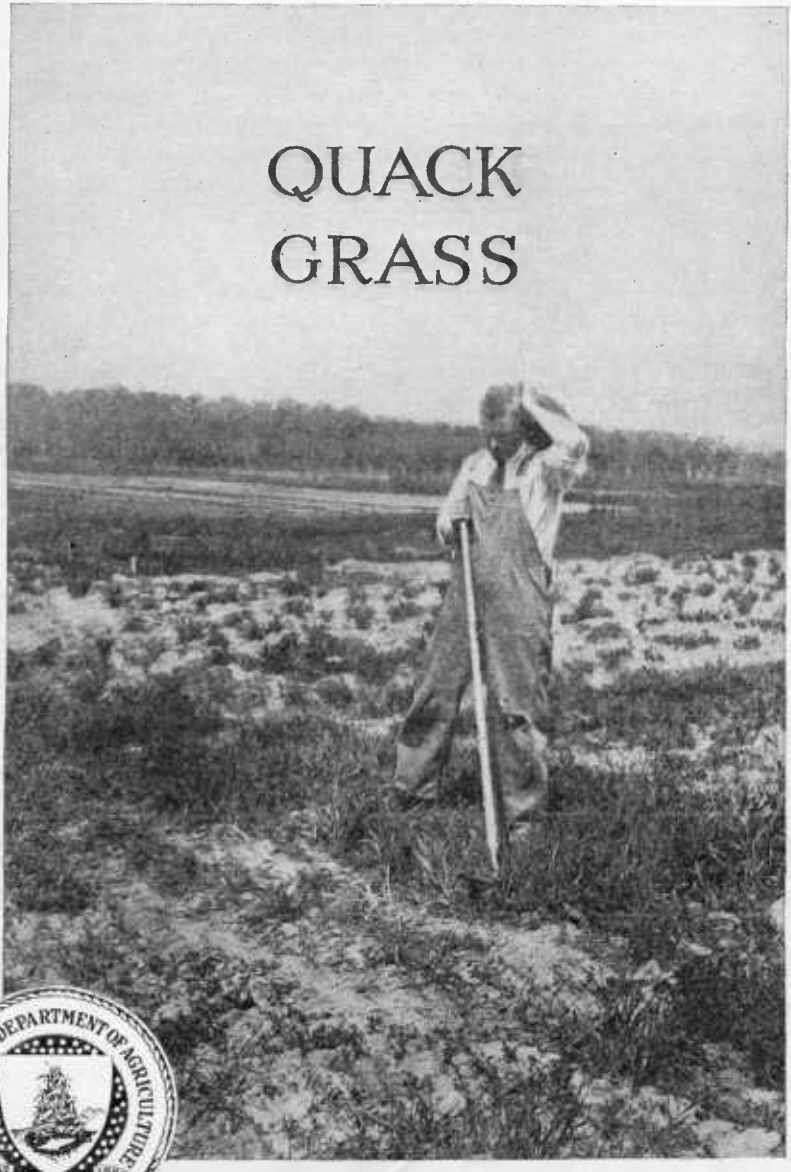
QUACK GRASS



QUACK GRASS, or witch grass, a creeping perennial grass related to common wheat, is one of the most widely distributed and destructive weeds in the North Temperate Zone. It is often confused with other grasses having similar names and habits, but it can be distinguished by the seed heads, the leaves, and the long, running rootstocks.

Quack grass can rarely be exterminated on large areas, but it can be brought under reasonable control. The best plan is to allow it to form a sod and then plow it in midsummer during dry hot weather. Attacking the weed in wet weather or in the spring when the rootstocks are growing vigorously is almost a waste of time. After plowing, the field should be harrowed frequently until winter and the following year planted with a cultivated crop. A smother crop may follow the cultivated crop. On small areas quack grass can be eradicated by hand digging, smothering with tar paper, spraying with chemicals, or by other means.

Quack grass makes good hay, pasturage, silage, and lawns and often can be utilized more economically than it can be destroyed.

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QUACK GRASS

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QUACK GRASS (also called "witch grass" and "couch grass"), is a vigorous, creeping perennial plant related to common wheat and widely distributed as a weed in cultivated ground in cool, moist climates. Thousands of acres of the richest soils in the northern and eastern United States are so overrun with quack grass as to be considered scarcely worth cultivating, while in several districts along the northern boundary whole farms have virtually been abandoned because the weed can not be controlled economically.

The character of quack grass as a weed is due to its remarkable system of creeping underground stems, or rootstocks, which spread through the soil in all directions, sprouting vigorously at the joints and resisting all but the most persistent efforts at extermination. Once well established in the field the weed is almost impossible to destroy. Quack grass is not entirely worthless, as it furnishes an acceptable quality of forage. The bad habits of the plant, however, outweigh its virtues.

DISTRIBUTION AND HISTORY

In America quack grass (*Agropyron repens*) occurs most abundantly in the region north of the Ohio and east of the Missouri Rivers. (Fig. 1.)[2] Within that area the weed is found in nearly every county, being in some localities the predominating plant. Quack grass has been found by botanists in every State north of Florida and Arizona, but it rarely causes trouble as a weed south of the latitude of Washington, D. C., and St. Louis. It occurs northward to the limits of cultivation, being abundant near Sitka, Alaska. During recent years quack grass has been invading valley

[1] Formerly engaged in weed investigations.

[2] This map is based upon records in the Division of Forage Crops and Diseases, Bureau of Plant Industry, and sketch maps furnished by officials of the following State agricultural experiment stations: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Virginia, West Virginia, Ohio, Kentucky, Indiana, Michigan, Wisconsin, Minnesota, North Dakota, Iowa, Missouri, Colorado, Wyoming, Idaho, California, Oregon, and Washington.

lands and irrigated soils in the Pacific Northwest and in the region of San Francisco Bay, where it gives promise of being as troublesome as in the East. Quack grass seldom thrives at altitudes greater than 2,000 feet, nor is it common in the semiarid regions of the Great Plains. In general, the distribution of quack grass corresponds very closely to that of timothy and red clover.

Quack grass undoubtedly is a native of Europe. Its early history in America is obscure. Some of the earliest explorers in New England reported the finding of fields of "wild wheat" on the shores of the St. Lawrence River and in the White Mountains. The grass which they observed, however, was probably dunegrass (*Elymus mollis*). The first authentic record of quack grass in America is that

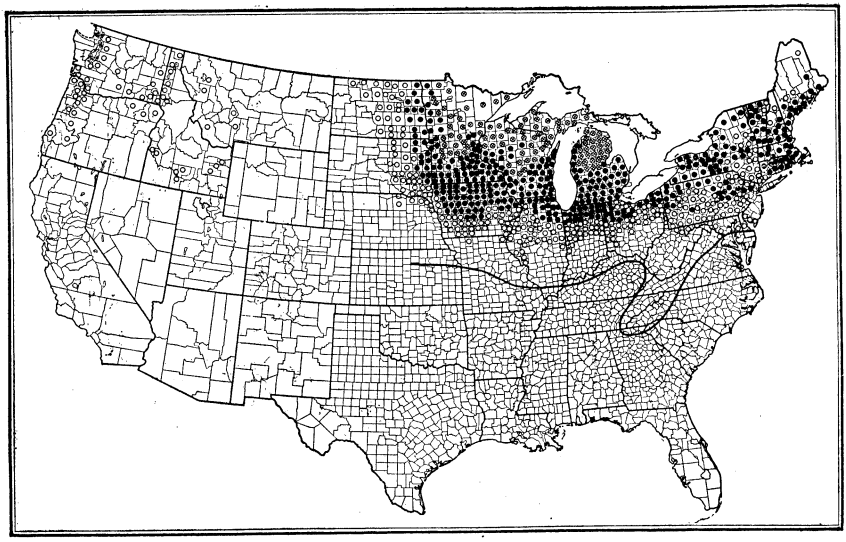

FIGURE 1.—Outline map of the United States, showing the regions in which quack grass is a troublesome weed. The dots show heavy infestation, the circles local infestation, and the crossed circles counties where the infestation is heavy but where agriculture is not highly developed. The solid line represents approximately the southern limit of quack grass as a weed

of the Rev. Jared Eliot, of Connecticut, a friend of Benjamin Franklin and one of the first reliable writers on American agriculture. Writing in 1751 he states: "Tillage will entirely destroy and extirpate all grasses and weeds; yea, even that stubborn grass called bluegrass (Dutch, wire, or couch grass) which is so hurtful to corn." In 1813 the grass was definitely identified by the botanist Muhlenberg as occurring in New Jersey and New England.

Quack grass first attracted serious attention about 1837, when it was noticed in gardens in the vicinity of Philadelphia. During the decade 1840–1850 the grass became generally distributed throughout the region east of the Allegheny Mountains. It was gradually carried westward by the emigrant settlers. By 1859 the weed had reached Kent County, Mich., and it was just entering Iowa and Wisconsin in 1875. Minnesota was reached about 1890, but the spread of the grass through the Dakotas and other Western States is

of comparatively recent date. At the present time the scene of the most active spread of quack grass is in the prairie Provinces of western Canada.

In the Old World quack grass has been a notorious pest as far back as there is definite record. In Lyte's translation of Dodoens, written in 1578, there is found the quaint but significant passage that "Couche grass is a naughty and hurtful weed to corne" (grain). Subsequently, nearly every writer on European agriculture has paid his respects to couch grass in no uncertain terms, and it remains to-day one of the two or three most troublesome weeds in Europe.

Quack grass occurs in all the countries of western Europe, and in Russia south to the Caspian Sea. In Siberia a river and a town are said to have been named for the grass, although the plant is not known to be common in other parts of Asia. A form of quack grass occurs in Algeria and Tunis, but not elsewhere in Africa. In the Southern Hemisphere quack grass is found occasionally in Argentina, and it is a weed of some importance in parts of Australia.

HOW TO RECOGNIZE QUACK GRASS

One of the principal reasons for the wide distribution of quack grass is the fact that it does not look like a weed. There are no bright, showy flowers, coarse, ugly leaves, or other features by which weeds are usually distinguished. To the casual observer the plant is simply a grass, and thus it works its way into the fields, becoming thoroughly established before it is recognized. It is very important, therefore, that the farmer be able to identify quack grass on sight.

In general appearance quack grass resembles a thin-headed variety of wheat. The plant is, in fact, closely related to wheat, and since there are not many wild grasses which resemble that cereal, the occurrence of a wheatlike grass in the field should be regarded with suspicion. The grasses which might be confused most commonly with quack grass on this account are: Western wheatgrass (*Agropyron smithii*), slender wheatgrass (*A. tenerum*), and wild-rye (*Elymus* spp.) in the Prairie and Rocky Mountain States, and Italian ryegrass (*Lolium multiflorum*) and perennial ryegrass (*L. perenne*) in the Eastern States. None of these grasses is hard to destroy.

Quack grass may be identified by its seed heads, leaves, and rootstocks.

SEED HEADS

The seed head of quack grass is a long, slender spike, about as long and half as wide as a head of wheat and having the seeds arranged flatwise to the stem rather than edgewise, as they are in the ryegrasses. (Fig. 2.) The heads sometimes bear short beards, and these, if present, break off at maturity. The seeds shatter easily when ripe, but usually remain inclosed in the hull, like small grains of oats.

LEAVES

The young leaf blade of quack grass is likely to bear at the base, at the point where it joins the stem, a pair of small yellow claws, or

horns, which project from the opposite edges of the leaf blade and nearly encircle the stem. (Fig. 3.) These claws are very characteristic of quack grass and are not prominent in any other common

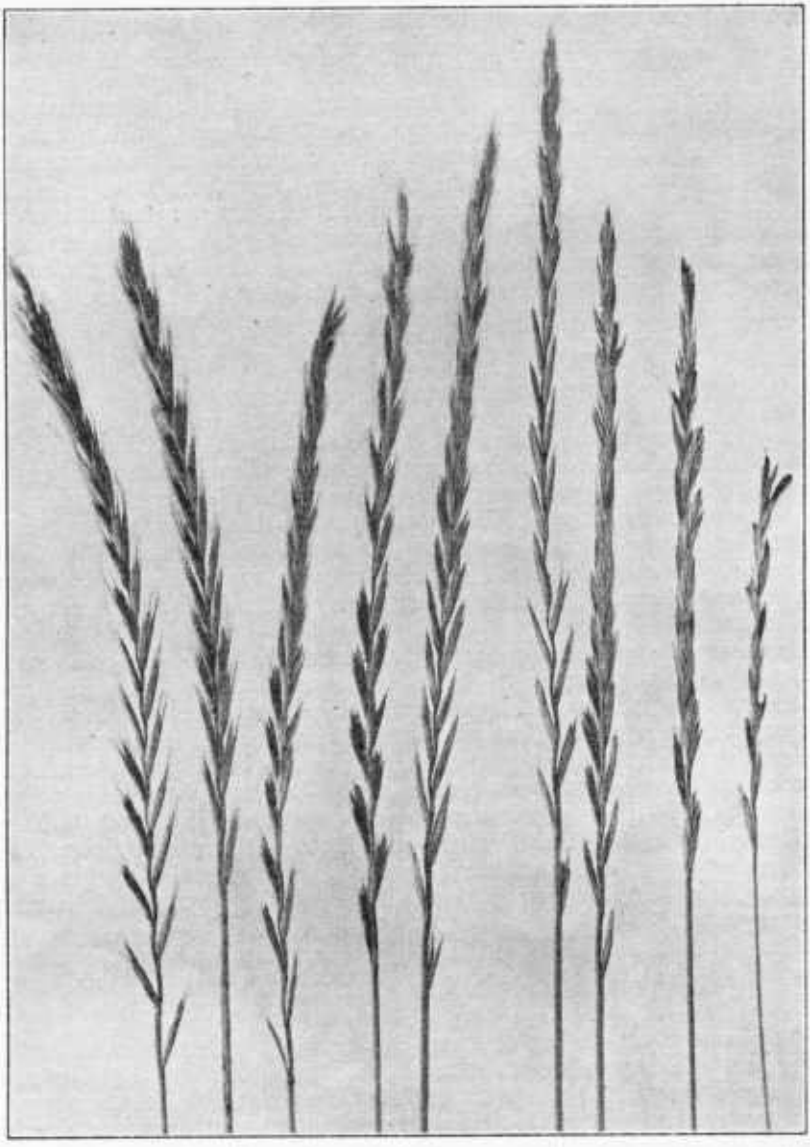

FIGURE 2.—The seed heads of quack grass are not unlike slender heads of wheat. Note that the clusters of seeds are arranged flatwise to the stem rather than edgewise

grasses except barley, wheat, and a few of the ryegrasses. A ragged membranous fringe, called the ligule, connects the claws at their bases. In many grasses the ligule is smooth or is replaced by hairs. The leaf blade itself is about the size and shape of a leaf blade of

timothy, but it is somewhat rougher on the edges and upper side and is more ascending, so that a patch of quack grass has a distinct bristly appearance. As in the case of rye, the quack-grass leaf often bears a curious slight constriction near the tip, as if a cord had been tied around the leaf and sharply pulled. (Fig. 4.) The portion of the leaf which incloses the stem has a tendency to be hairy when young and may be either split lengthwise or formed in a solid tube. The leaf blade is rolled, not folded, in the bud.

The color of quack-grass leaves varies. In the Western and Southern States the plants are often covered with a whitish bloom, which gives the leaves a bluish aspect. In the Eastern States the leaves are usually a rich dark green, readily distinguishable from the paler greens of timothy and wheat.

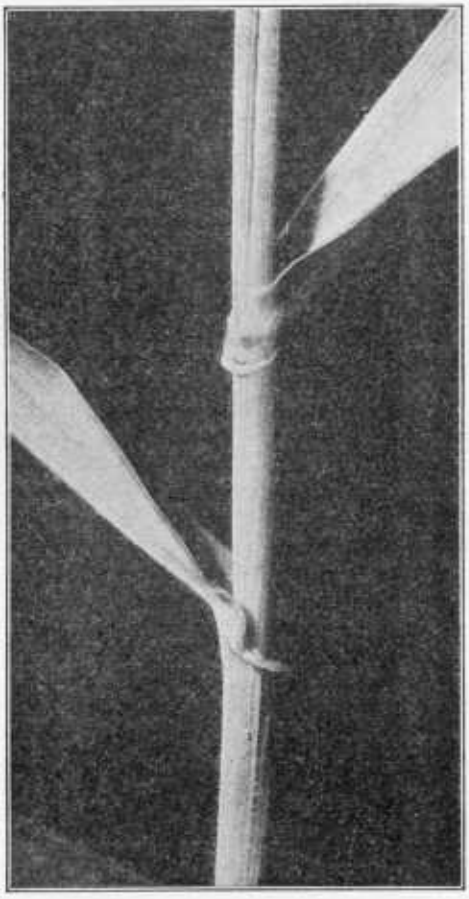

FIGURE 3.—The two long curved horns or claws at the base of the young quack-grass leaf blade are an aid in identification. (Magnified 4 times)

ROOTSTOCKS

By far the most important characteristic of quack grass is the elaborate system of creeping underground stems, or rootstocks, commonly miscalled "roots." (Fig. 5.) Very few grasses common in the Northern States are equipped with such extensive underground organs, and finding them beneath a stand of grass constitutes an almost positive clue to the nature of the species. In the Eastern and Central States the only other important rootstock grasses are Kentucky bluegrass and Canada bluegrass (*Poa pratensis* and *P. compressa*), redtop (*Agrostis palustris*), and nimble Will (*Muhlenbergia schreberi*). In the West and Northwest bromegrass (*Bromus inermis*), bluejoint (*Calamagrostis canadensis*), and western wheatgrass and in the South Johnson grass (*Andropogon halepensis*) and Bermuda grass (*Cynodon dactylon*) possess rootstocks. In none of these except western wheatgrass does the seed head at all resemble that of quack grass.

The quack-grass rootstocks are long, slender, cordlike, yellowish white structures, about one-eighth of an inch in diameter, smooth,

bare, and hollow except at the joints, where they are solid and closely covered with scaly rudimentary leaves. Branches are produced freely by the rootstocks, one at nearly every joint, and they in turn may become branched or push to the surface to form leafy shoots. If the rootstocks are broken, branches may arise from any joint along their length. Ordinarily, most of the branches form near the tips. When a rootstock strikes an obstruction it often breaks up into a snarl of twisted branches. If not obstructed, it may grow straight through the soil for a foot or more without branching. A collection of rootstocks usually is a tough, tangled mass of stems very difficult to separate. When fresh, the rootstocks are firm, juicy, and tough, except at the joints, where they break with a clean fracture. As they dry, the rootstocks become brittle and are easily broken. The tip of each rootstock is armed with a sharp, hard point, which can penetrate the hardest soil or even a piece of soft wood or a potato.

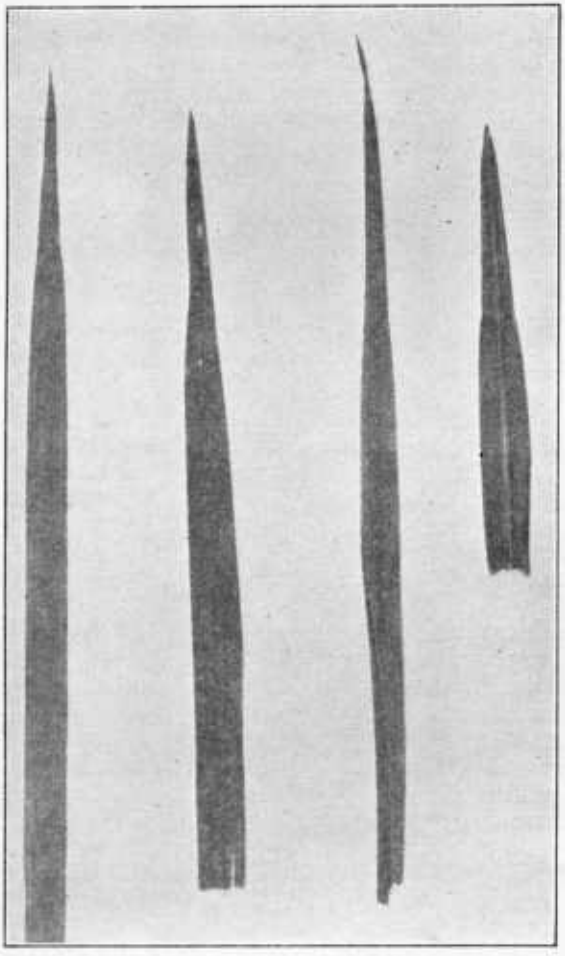

FIGURE 4.—Quack-grass leaves; often characterized by a pinched appearance just below the tip

The rootstocks have little to do with the absorption of food material and moisture from the soil, but serve as a means of spreading and as storehouses of food material. The true roots of quack grass are mere fibers arising from the joints at the bases of the stems and on the rootstocks.

COMMON NAMES OF QUACK GRASS

The spread of quack grass has been greatly aided by the lack of a single commonly accepted name and by the fact that the names that have been applied also have been used indiscriminately for almost any troublesome grass with running roots. The confusion of

names has made it difficult to focus attention on the plant and has hindered concerted efforts at eradication. More than a hundred different names are known to have been in use, most of them variations of an old Anglo-Saxon word "cwicė" or "quis," meaning lively

FIGURE 5.—Typical quack-grass rootstocks. The weight of these creeping, sprouting underground stems often exceeds the weight of the stems and leaves above ground. The fibrous masses are the true roots. The green leaves may be seen above the mass of rootstocks

or vivacious. Typical derivations of this word appear in the common forms quitch, witch, quick, queck, quack, crack, crouch, couch, scutch, and Scotch. In addition, such names as dog, drag, Durfee's, Chandler's, and English have had a local vogue.

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At present quack grass or some closely similar word is supplanting other terms in English and German speaking countries, although witch grass is still popular in New England and couch grass in some of the British possessions.

HOW QUACK GRASS IS INJURIOUS

DAMAGE TO CROPS

Quack grass is an injurious weed only in plowed ground. In grasslands or roadsides and in waste places it is harmless, except as a source of infestation, and may even be beneficial through the herbage that it adds to meadows and pastures.

The chief sufferers from quack grass are the small-grain crops, potatoes, beans, and garden crops. Spring grain is more likely to be injured than winter grain, partly because it starts growth at the same time as quack grass, and partly because it is often planted hurriedly in the spring on poorly prepared ground. The yield of spring oats and spring wheat is often reduced 40 to 50 per cent by quack grass; barley suffers somewhat less, while rye and winter wheat are injured only occasionally. Fields of potatoes and beans are often veritable meadows of quack grass in the fall, because the spreading habit of these crops makes it hard to keep the grass out of the rows late in the season. Corn and sugar beets are kept clean more easily than potatoes and are not likely to be injured severely by quack grass, provided the weed is kept down during the early part of the season. Quack grass that grows up in cornfields late in the summer does not appear materially to reduce the yield of either grain or stover.

Quack grass is often troublesome in orchards and vineyards; however, it does not seem to injure the trees and vines to any greater extent than does other grass. Strawberry patches and asparagus beds are almost totally destroyed if quack grass gets into them, as there is no way of killing the grass without killing the crop. Home gardens are among the worst sufferers from quack grass. Large market gardens are not bothered excessively, owing to the more frequent and careful cultivation they receive. Crops like buckwheat, hemp, millet, sweetclover, fodder corn, sorghum, vetch, and rape, that make a quick and heavy growth, often are not injured by quack grass and may even be of service in eradicating the weed.

Quack grass not only reduces the yield of crops but injures their quality. In some sections the sharp-pointed quack-grass rootstocks so frequently cause malformation of potatoes and other root crops that the market grade of the crop is lowered. Most of the larger field seeds such as the grains and the larger grass seeds are almost unsalable if they contain quack-grass seed in quantity. The culture of bromegrass and the wheatgrasses in the Western States has been seriously curtailed through fear of introducing quack grass.

In common with many other grasses, quack grass is an active agent in spreading the red rust of wheat. It is also a frequent carrier of the poisonous fungus known as ergot and acts as a harbor during winter for the Hessian fly and other injurious insects.

LABOR COST

Although damage to crops is the most obvious injury caused by quack grass, by far the most serious charge against this weed is the labor cost of keeping it under control. There is no way of estimating the amount of money spent each year in combating quack grass, but without question the total is huge. Carefully kept accounts indicate that the cost of growing potatoes and beans is increased 15 to 40 per cent if quack grass is present in the field. Similar figures probably apply to other cultivated crops. Although the labor factor is commonly overlooked, in reality it is the most convincing argument against allowing quack grass to remain on a farm.

EFFECT ON LAND VALUES

The presence of quack grass in any quantity causes a sharp lowering in the market value of land. In neighborhoods where good land is worth $150 an acre a farm that is known to be infested with quack grass often can not be sold for half that figure. Many farmers do not consider quack-grass land a bargain at any price. In the opinion of experienced real-estate dealers the average depreciation of farm lands infested with quack grass is not less than 25 per cent. If the weed is eradicated from such land the market value increases proportionately.

HABITS OF QUACK GRASS

Quack grass has few weaknesses that can be used to advantage in controlling it. Nevertheless, it is weaker at some periods than at others, and knowledge of its habits may save much time and energy otherwise wasted.

LENGTH OF LIFE

Quack grass usually can not be killed merely by cutting to prevent seed ripening. Although the individual rootstocks rarely live more than 15 months, the formation of new rootstocks is such a continuous process that the plant can live indefinitely, even though no seeds are formed. Instances are not rare in which old grasslands that had not produced quack-grass seeds in more than 20 years gave rise to vigorous patches of the weed when the sod was plowed and the rootstocks were broken up.

CLIMATE AND SOIL PREFERENCES

Quack grass makes its most luxuriant growth in cool, moist climates and in rich soils. It grows but weakly in regions of long, hot summers, although it is able to withstand short periods of very dry weather better than most grasses. It thrives as far north as the limits of cultivation and practically never winterkills. Quack grass is one of the first plants to start growth in the spring and one of the last to stay green in the fall. In the latitude of the Corn Belt it is earlier than any other grass except ryegrass and orchard grass, often having shoots 2 inches long before winter wheat resumes growth.

Quack grass grows equally well in sandy, clayey, or gravelly soils, the extent of growth depending entirely upon the supply of water and plant food. It never occurs in swampy places or on muck soils or peat, and, conversely, seldom is troublesome on dry hillsides or other poor, hard soils devoid of organic matter. That the plant can withstand the presence of fairly large quantities of salt in the soil is shown by its occurrence on irrigated alkali ground in the West and its presence on the New England seacoast, where it sometimes grows right down to the water's edge. Experiments with chemical weed killers have shown that quack grass survives an application of 20 tons or more of dry salt to the acre.

SEED HABITS

An average head of quack grass contains about 25 viable seeds, and as a rule the seed heads are not so numerous as those in a good stand of wheat. In a test at Lansing, Mich., in 1916, the yield of quack-grass seed was at the rate of about 18 bushels per acre.

The production of seed depends somewhat upon the ease with which the plant spreads underground. When the rootstocks are free to develop rapidly, as in loose cultivated soil, the plant produces but little seed. When the rootstocks are closely crowded, as in grasslands, the seed heads are abundant. Similarly, more seed is produced on poor soil than on good soil, and more in dry seasons than in seasons of plentiful rainfall.

Like those of many other grasses, the seeds of quack grass are short lived and do not germinate well. When kept in open containers, such as grain bins, or sacks, most of the seeds lose their power to germinate in about four years. An occasional seed, however, retains its vitality for a much longer period. Hence, hay, grain, or other materials known to contain quack-grass seeds should be used with caution. When buried in the soil all quack-grass seeds within the upper 3 inches either germinate or die within two years. Those buried at a greater depth may persist for five years or more and grow when brought to the surface. Seeds that find their way into the silo usually have lost their power to germinate by the time the silage is removed. In manure the seeds retain their vitality for from one to six months, depending upon the degree of heat and moisture in the pile. Very dry, trashy manure that has not heated is dangerous to spread upon the land until it is more than a year old. In wet, heavy manure the seeds usually decompose in six to eight weeks. The decay of the seeds can be hastened by turning the pile inside out about once a month, as the seeds in the center decay more rapidly than those on the outside.

Fresh seeds of quack grass seldom show a germination rate of more than 50 per cent. Germination increases slightly with age and may reach 70 per cent by the time the seeds are 6 months old. One cause of the low germination is the presence on the seeds of a species of rust, which frequently attacks the plant very heavily in the fall. Quack grass often is so badly rusted, especially in the Northern Central States, that only four or five viable seeds are to be found in each head.

In common with many weed seeds the seeds of quack grass have the very dangerous characteristic of being able to germinate before they are fully ripe. Experiments conducted at the Minnesota Agricultural Experiment Station have shown that some of the quack-grass seeds are able to grow before the plant is fairly out of blossom. Germination of over 30 per cent was obtained from seeds gathered in the hard-dough stage, which occurs about two weeks before the seeds usually are considered ripe. Any crop that is harvested after July 1 in the southern part of the quack-grass region or after July 15 in the northern part, therefore, is likely to carry viable seeds of the weed.

While quack-grass seeds germinate most abundantly in early spring and in early fall, they may germinate at any time during the growing season, provided there is sufficient moisture in the soil. Plants that grow from seed in the fall usually produce seed the next year, but spring seedlings seldom bear seeds until the second summer.

ROOTSTOCK HABITS

The first rootstocks do not appear on the quack-grass seedlings until the second or third month, or when the leaves are about 6 inches long. (Fig. 6.) Until that time quack-grass seedlings are hardly dintinguishable from other grass seedlings and are easily destroyed by cultivation. When the rootstocks begin to form, however, they multiply rapidly and send up leafy shoots in profusion. A single quack-grass seedling in the course of a season gives rise to a patch of grass a foot or more in diameter. If not destroyed, such a patch widens in all directions at the rate of a foot or more a year. Most of the rootstocks are crowded in the upper 8 or 10 inches of the soil, and very few are found lower than a foot below the surface. The extent of the rootstock system of a single plant often exceeds the combined lengths of the aboveground stems. Individual plants that had been carefully dug up contained nearly 50 feet of "root" system and had 40 or more seed-bearing stems and over 200 leaves. Not infrequently an entire patch of quack grass measuring several feet in diameter is connected by the same set of rootstocks and in a single plant.

It is commonly believed that quack grass has been widely distributed by means of dried pieces of rootstock carried in hay, straw, packing material, the roots of nursery material, in shipments of potatoes, and in similar ways. The danger from this type of infestation appears to depend somewhat on the rapidity with which the rootstocks are dried. The tops of quack grass kept in the greenhouse for four months without water died and the soil became very dry. When the soil was watered at the end of four months the grass began to grow as vigorously as ever. On the other hand, bare fresh rootstocks which were exposed to the direct rays of the July sun for eight hours ceased to grow, even when artificially forced. It should be remembered, however, that in the field the rootstocks seldom become thoroughly dry, because of the rootlets and particles of soil which adhere to them.

By far the most important habit of quack grass is its tendency to become root bound when allowed to grow without molestation.

In an old pasture or meadow the rootstocks usually are massed in a thin layer just beneath the surface, while in a cultivated field they are scattered through the soil to a depth of 8 or 10 inches. This fact is of the utmost importance in attempting to control this weed and is its weakest known point.

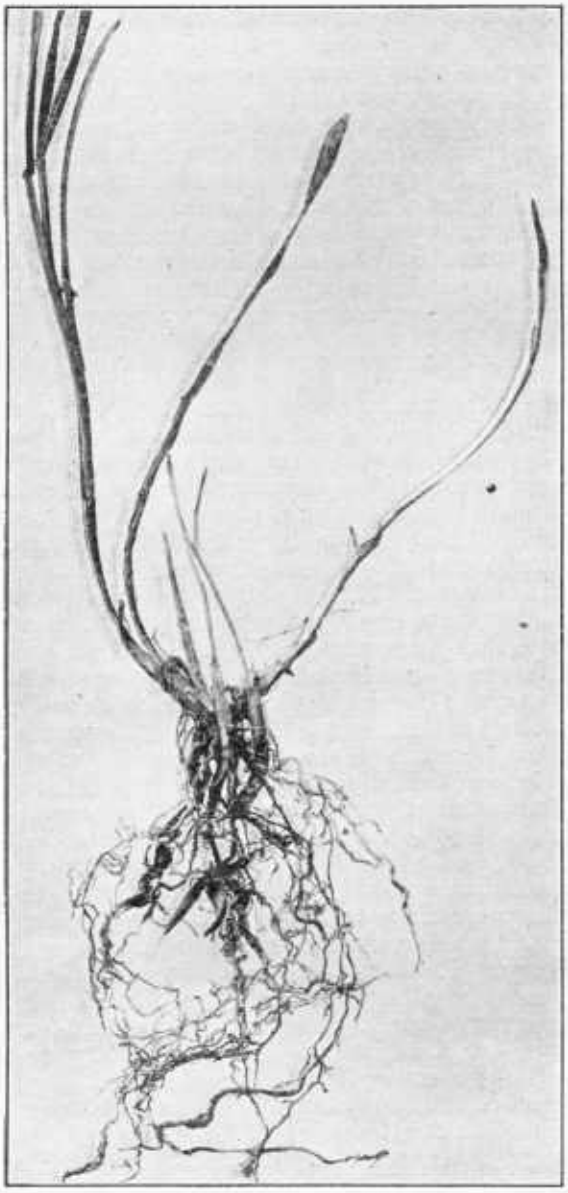

FIGURE 6.—Quack-grass seedling 2 months old. The rootstocks are just beginning to develop and will not be large enough to be troublesome for another month

CONTROL PRINCIPLES

There is no quick and easy method of controlling quack grass, nor is there any one system that is satisfactory under all circumstances. Weather conditions, the kinds of crops grown, the supply of labor, and many other factors influence the choice of method, and these conditions vary widely in different localities and even on the same farm in different years.

Experience has shown, however, that certain phases of quack-grass control are fairly constant and dependable, and these may be accepted as principles upon which the practice of control should be based.

WEATHER

Quack-grass control depends more than anything else upon the character of the season. Fair weather is absolutely essential. Unless the season is reasonably dry and warm, little headway can be made. Indeed, cultivation in wet

weather is decidedly worse than useless and should be avoided under all circumstances, as the weed not only is not harmed but is actually benefited. Wet weather, of course, can not be foretold, and it often happens that rainy weather sets in after a campaign of eradication is well under way. Under such circumstances the only thing to do is to accept the situation philosophically, abandon the work temporarily, and await a more favorable season.

Excessively dry weather is sometimes as bad as wet weather. During long rainless periods the rootstocks dry out slowly and become dormant. The leaves cease to grow, and in that condition the plants are not injured by harrowing or cultivating.

In general, the ideal time for killing quack grass is when the days are hot and the nights are cool, and the soil is just moist enough to keep the grass growing.

TIME OF YEAR

The best time to attack quack grass is in midsummer, just as the plants are forming seeds. Not only is there greater likelihood of favorable weather at that time, but the rootstocks are then at their point of lowest vitality. In spring and fall the plants make heavy vegetative growth and store large quantities of reserve food material in the rootstocks. In midsummer vegetative growth is less active and the plants make a supreme effort to produce seed, the formation of new rootstocks practically ceasing and the old ones being drawn upon heavily for their reserve food material. In this weakened condition the rootstocks are less able to withstand attack and are much more easily killed than at other times of the year. In experiments at the Arlington Experiment Farm, near Washington, D. C., the weight of the rootstocks beneath an average stand of quack grass was found to be at the rate of about 5,500 pounds per acre in April, 3,500 pounds in August, and 5,300 pounds in November, with a corresponding decrease in the content of starchy food material in midsummer. Other experiments showed that four cultivations begun in July were as effective in destroying quack grass as six to eight cultivations begun in April. A further advantage of beginning in July is that the work is more likely to be done carefully in midsummer because other farm work is less pressing.

SIZE OF AREA

On large tracts of thoroughly infested land quack grass can rarely be completely exterminated. Even with the most careful culture a few rootstocks are certain to persist and these are enough to reinfest the area. The best that can ordinarily be expected is to bring the weed under reasonable control and by the use of a proper system keep it within such bounds that cultivated crops can be grown for four or five years at a time without undue interference. If one will reconcile himself to this fact and be content to control the weed rather than to eradicate it the problem will seem much less irksome.

On small areas quack grass can and should be absolutely destroyed. Success on small areas depends entirely on the amount of time and effort one is willing to spend on the work.

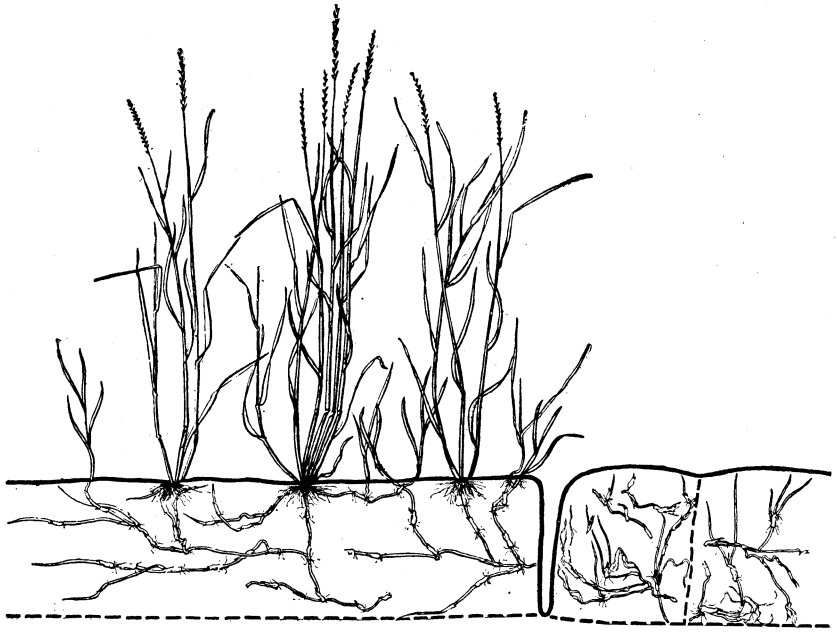

FIGURE 7.—Diagram showing the effect of plowing a cultivated field 7 inches deep. The rootstocks are merely mixed more thoroughly into the soil

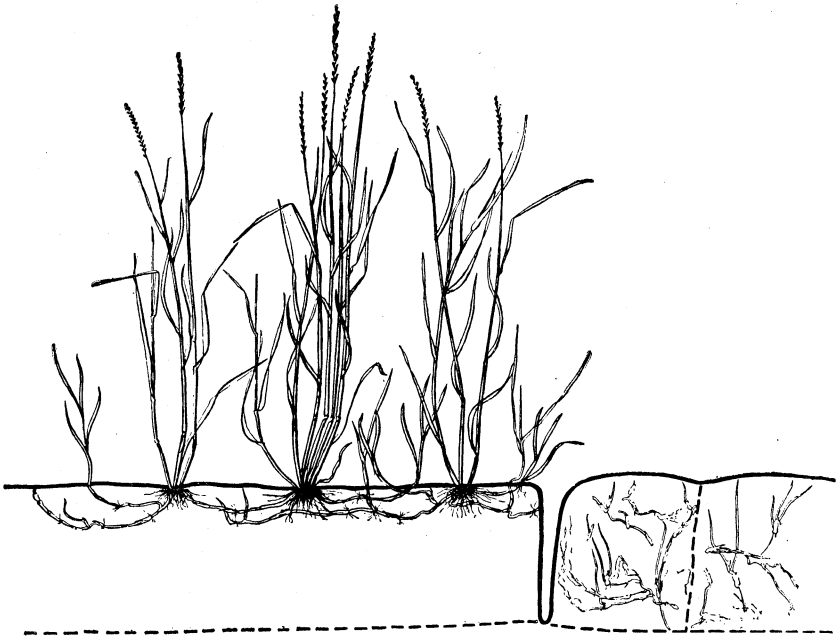

FIGURE 8.—Diagram showing the effect of plowing a pastured field 7 inches deep. The rootstocks are remixed through the soil to the depth of the furrow slice

PLOWED AND UNPLOWED LAND

The tendency of quack grass to become root bound has already been noted. Because of this tendency quack grass is far easier to control in grassland than in land that has been in cultivated crops.

The difference between plowed and unplowed land and the effect of different methods of plowing on quack grass are illustrated in the accompanying diagrams.

Figure 7 represents the cross section of a field that has been plowed and cultivated in the ordinary manner. In this field the quack-grass rootstocks are scattered through the soil to the depth of the furrow

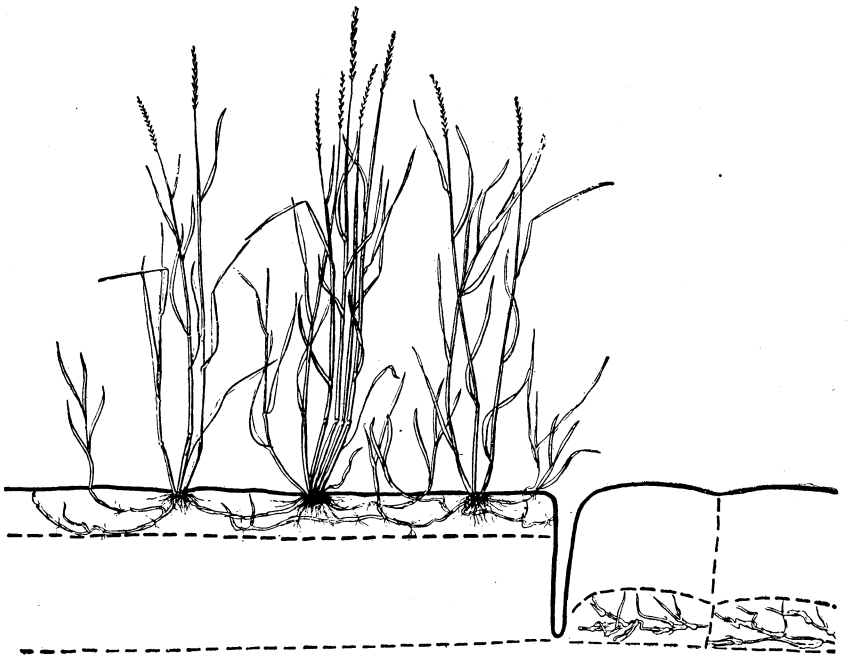

FIGURE 9.—Diagram showing the effect of double plowing a pastured field and burying the rootstocks under 12 inches of soil. An effective method of destroying quack grass, but expensive and laborious

slice. When such a field is plowed, as at the right of the diagram, the rootstocks are simply mixed more thoroughly into the soil and the field is in no better condition than before.

Figure 8 represents a similar field that has been left in grass for a year or so. Here the rootstocks have become massed in a shallow layer just beneath the surface. The field, however, was plowed at the regular depth, thereby redistributing the rootstocks through the soil and putting the weed back in its original condition.

In Figure 9 is illustrated an effective, but expensive, control system. In this system the field is in grass and two plows are used. The first plow goes only 4 inches deep and throws the mass of rootstocks into the bottom of a deep furrow alongside. The second plow follows immediately behind the first in the same furrow,

plowing an additional 8 inches and throwing the soil on top of the rootstocks just turned. In this way the rootstocks are buried under 8 to 12 inches of soil and are nearly all killed at one operation. When this type of plowing is carefully followed the results are very satisfactory. The work requires skillful plowmen and special types of plows, however, and the soil must be deep and easily turned. Only rarely is it worth the extra cost.

The best method of plowing quack-grass land is that shown in Figure 10. Here the field has been in grass, but the sod, instead of being plowed deep, has been turned very shallow and the rootstocks have been left in a compact mass near the surface, where they can be readily stirred by the harrow and dried.

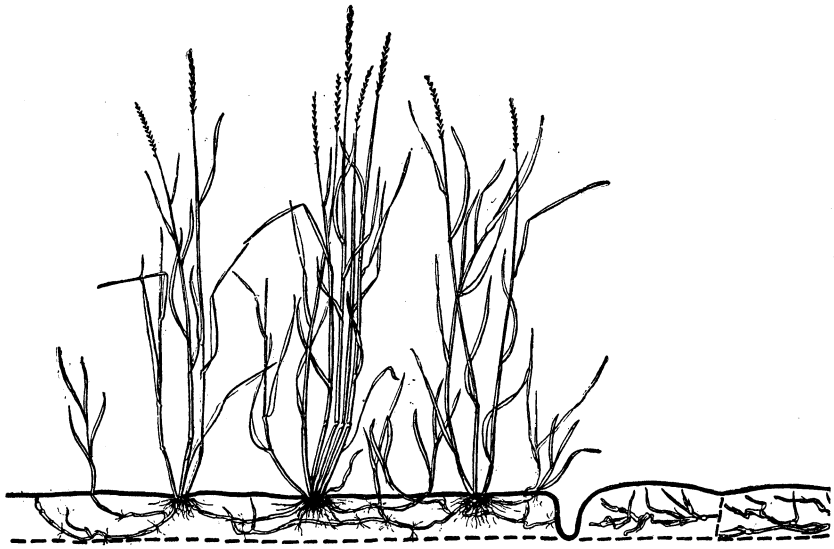

FIGURE 10.—Diagram showing the effect of shallow plowing on a pastured field, the easiest way to destroy quack grass. The rootstocks are all left within reach of the harrow

CULTIVATION

Cultivation of a crop like corn or potatoes, as that operation is usually performed, is almost entirely worthless as a means of destroying quack grass. On the contrary, it is one of the most effective means of spreading the weed over a farm. Instead of harming the grass the teeth of the implement tear out the rootstocks, break them in pieces, and drag them down the row, setting up a new area of infestation wherever a piece is dropped. The cultivator and the harrow are among the most effective distributors of quack grass on the farm, and if carelessly handled may do more harm in a single hour than can be overcome in several years.

To be effective against quack grass, cultivation and harrowing must be thorough, frequent, and persistent. Halfway cultivation is worse than none. The weed thrives on an occasional stirring, and if it is to be destroyed it must be cultivated so often that it does not have a chance to become rooted. There is scarcely a better way to make two blades of grass grow in place of one than to cultivate a patch of quack grass at long intervals.

CONTROL PRACTICES

A USEFUL ROTATION

Based on the general principles already mentioned, the following system of cropping is suggested as a means of holding quack grass in check on large areas. Such a system can seldom be followed exactly, but on most farms it can be modified to meet local conditions and will serve as a basis on which to work:

Seed the land to grass, pasture it closely, or cut it for hay.
As soon as the grass is sod bound, plow shallow in July immediately after haying.
Harrow as often as new leaves appear until frost.
In the spring plant a cultivated crop.
The following year, if the grass is still abundant, sow a thick smother crop.

SEEDING TO GRASS

The object of seeding to grass is to obtain a tight, thin sod with the rootstocks matted near the surface. If possible, the field should be used for pasture, as this makes the most compact sod. In heavy clay soil that is closely pastured, the grass will become densely sodded within a year or 18 months. In sandy soils from two to four years are required. Hayfields require about a year longer than pasture fields to become well root bound. For grazing purposes horses and sheep are better than cattle, as they bite more closely and trample the ground more. Sometimes an infested garden can be converted temporarily into a poultry yard, or a lawn, and another area used as a garden.

PLOWING

When the rootstocks have been brought near the surface, plow in midsummer at the time the quack grass normally would be in full bloom. This occurs in most parts of the northern United States between June 20 and July 10, although blossoming may be delayed if the season is dry. Plowing should be only to the depth necessary to get under the lowest live rootstocks. In an old pasture 3 inches is sufficient; in a meadow from 3 to 6 inches. In cultivated land it sometimes is unnecessary to plow to a depth of more than 4 inches, because the old rootstocks at the lowest depths are often so exhausted that they are not dangerous. Turn the furrow flat and cover all the leaves completely, being particularly careful to plow out the back furrows.

Plowing to a depth of only 3 or 4 inches with the ordinary stubble plow found on most farms is somewhat difficult, although it can be done with a steady team. When large areas are to be plowed it usually pays to obtain a special sod plow designed to turn a thin flat furrow. The so-called prairie breaker (fig. 11) is excellent for this purpose, although somewhat heavier than necessary. A type of plow known by some manufacturers as the Scotch bottom or clipper bottom also does good work and can be used for general plowing as well. Some so-called Scotch-bottom plows, however, are especially designed to turn the furrows on edge, which, of course, is not the result desired in this case. If the sod is hard and tough a rolling colter, a fin colter, or the combined colter and jointer helps to cut the rootstocks. When plowing a meadow that for any reason

has not been mowed it will be necessary to attach a light chain or a No. 9 wire from the clevis to the handle near the end of the moldboard, in order to turn the tops under the shallow furrow.

HARROWING

After plowing let the field alone for a week or 10 days or until the grass has begun to send up new leaves. This helps to exhaust the rootstocks. When the new leaves have reached a length of about an inch, harrow the field crosswise with a spring-tooth harrow, to tear the chunks of rootstocks apart and to shake off the soil. Repeat this operation as often as the quack-grass leaves become an inch long. In seasons of normal rainfall 4 or 5 harrowings before frost will be enough, although the number may run as high as 8 or 10 if the growing conditions are especially favorable.

The best all-round harrow for subduing quack grass is the spring-tooth type, although there are a number of special quack-grass harrows that do excellent work. The disk harrow, either plain or cut-

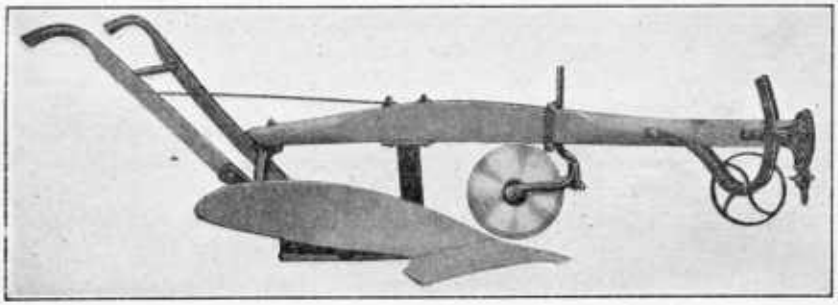

FIGURE 11.—The prairie breaker, a plow with a long narrow moldboard especially designed for turning a shallow flat furrow, a very useful implement in fighting quack grass. The rolling colter aids in cutting the tough rootstocks

away, is a good tool, provided the work is well done. The disks cut the rootstocks into small pieces, however, instead of dragging them out as does the spring-tooth harrow, and these small pieces are likely to take root again if the field is not harrowed frequently. The spike-tooth harrow and the duck-foot types are useful in soils that are not loose or stony.

Always choose a hot, dry day on which to harrow and try to stir and turn the rootstocks to aid in drying them. Often the dry rootstocks can be raked into piles with the harrow or a hayrake, after which they should be carted away and burned.

In the fall, if the rootstocks are not well loosened from the ground, plowing should be repeated. Allow the field to remain rough over winter, to expose the rootstocks to the frost. If there is danger of soil washing, sow a bushel of rye to the acre as a cover crop.

CULTIVATED CROPS

In the spring, as soon as the weather permits, loosen the rootstocks from the soil with the harrow. Do not plow unless the ground is very hard or the grass firmly rooted. Lack of plowing will not injure most crops. Plant a cultivated crop that is easily kept clean,

corn in checkrows usually being the most convenient. Sugar beets also are excellent, as they require close cultivation and can be kept clean in the rows. In some sections soybeans in rows for seed have proved very satisfactory. Potatoes, tomatoes, cannery peas, and bushy types of field beans are to be avoided, as it is practically impossible to keep the weeds out of the rows of these crops during the latter part of the season. Tobacco is unsatisfactory, because it is too easily injured.

Of the many types the disk cultivator is one of the best for subduing quack grass. If the ground is not stony the disks cut the grass off cleanly, do not clog, and are easily handled. The disks must be kept sharp, which is sometimes difficult in sandy soil. In gravelly and stony soils there is nothing better than the ordinary 5-shovel or 6-shovel corn cultivator, although the spike-tooth or harrow-tooth cultivator, where it can be used, tears out more of the grass. Cultivators of the scraping or knife-blade type, as well as duck-foot implements, are excellent when sharp, but are quickly dulled, in which condition they tend to jump and slide over the weed and to push it ahead instead of cutting it.

SMOTHER CROPS

A smother crop is any crop that makes a heavy, dense growth and kills the weeds by crowding and shading. In very rich soils the smother crop can sometimes be used in place of the cultivated crop the first year after the ground is plowed. Ordinarily, however, the smother crop must follow the cultivated crop, as otherwise it can not be depended upon to make a sufficiently heavy growth to kill quack grass. Its purpose is to clean up the stray plants that escape the cultivator. Since a smother crop must make a dense growth to be of any service, it usually pays to fertilize this crop heavily with manure or commercial fertilizer.

Almost any crop that produces a rank growth can be used for smothering. Corn in thick rows for fodder is perhaps the most generally useful. It should be planted with a drill in rows 2 feet apart, using not less than 2 bushels of seed to the acre. If the corn makes a sufficient growth to smother the quack grass it will not need cultivating after the first two weeks.

Buckwheat is fairly effective as a destroyer of quack grass. (Fig. 12.) The particular advantage of buckwheat is that it need not be planted until the end of June, thus allowing time for the cultivation of the ground during the spring. This fact is a disadvantage, however, if the cultivation is neglected. Buckwheat must be planted on well-prepared ground and should be seeded at the rate of at least 5 pecks to the acre.

Hemp is an excellent smother crop in regions suited to its growth. Under present conditions it is not a profitable crop unless there are local milling facilities for preparing the fiber. Still, for killing weeds on a small scale, it may be found generally useful. According to the Wisconsin College of Agriculture, hemp is the best crop for smothering weeds in that State; yet soil infested with quack grass must first be prepared properly in order to destroy the mat of weed roots and thus give the hemp a chance. A good method is to plow such soil in late summer or early fall and work it thoroughly with

a spring-toothed harrow until freezing weather. All loosened roots should be raked together and burned. In the fall, if the land is not fertile, it should be given a heavy application of manure. Beginning in early spring, thorough working of the soil should be continued until the date of seeding the hemp. If the weeds are thoroughly subdued and kept under control until the hemp is planted, good results will be obtained; otherwise the weeds are likely to choke out the hemp.

Rape, especially the Dwarf Essex variety, is a good smother crop if planted in thick rows on rich soil. It has been especially recommended for controlling quack grass in parts of Canada. Under the method in which the crop is usually grown in this country, however, it does not make a growth heavy enough to have much effect on the weed.

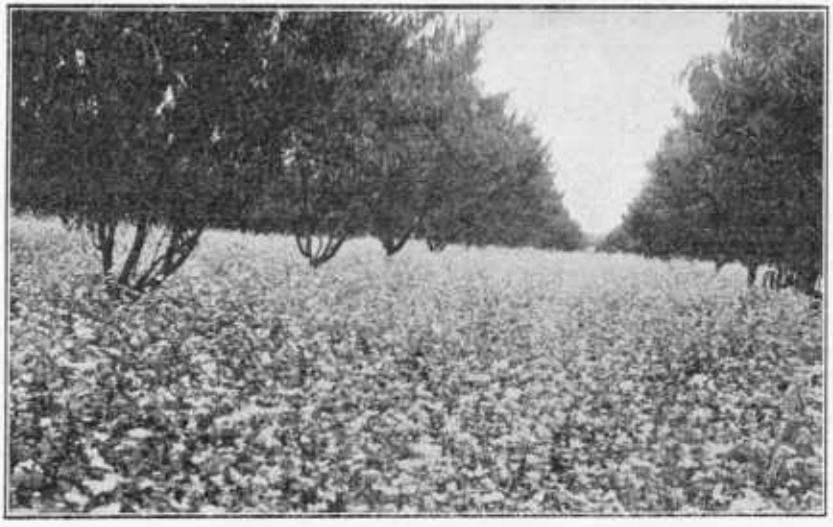

FIGURE 12.—A thick, rapid-growing smother crop is very useful in following a cultivated crop and cleaning up stray plants of quack grass. Buckwheat is often used for this purpose

Spring barley, following a season of clean cultivation, has been used with very good results in some of the Western States. Barley is more leafy than the other small grains and is well able to hold its own against quack grass.

Peas or vetch with oats, which have been used with success in the cool portions of the more northern States, especially in the Pacific Northwest, are useful only on rich soils well supplied with moisture.

Golden millet, also known as German millet, has long been known as a good smother crop, but this reputation is scarcely deserved so far as quack grass is concerned. The millet grows but little taller than quack grass, and if the soil is sufficiently rich to make a large growth of millet the quack grass also is encouraged.

Recently sunflowers have attracted attention as a smother crop for quack grass and are reported to have been very satisfactory in northern Michigan and South Dakota. They must be planted thick and should be given a good application of fertilizer to start them rapidly.

In the region south of the latitude of Chicago, Red Amber sorghum is a good smother crop. It should be planted in 14-inch rows with a grain drill and allowed to mature for seed.

Sweetclover has sometimes been known to smother quack grass, and where it makes a rank growth it may destroy the weed. The plants must be thick on the ground, however, and must attain a height of not less than 6 feet. Unless the soil is very rich the sweetclover and quack grass are likely to grow excellently together, making a good forage combination, but not eradicating the weed pest.

CHEMICAL WEED KILLERS

Weed-killing chemicals, because of their cost and other objections, are not a substitute for tillage and cropping methods in dealing with quack grass on a large scale. On small areas, or under special circumstances, chemicals are sometimes useful. The first small patch of quack grass may often be killed more quickly and more conveniently with chemicals than by other means. Around fence rows, foundation walls, gutters, oil tanks, and similar inconvenient places it is easier to spray a chemical solution than to work with tillage tools. No chemical is known that will destroy quack grass at one reasonable application; at least two and often three or four treatments are needed before the last spear of grass disappears.

Among the large number of chemicals that have been tried on quack grass, three have been found the most useful.

Fuel oil, or other low-cost viscous petroleum oil, sprayed on quack grass at the rate of 300 to 400 gallons an acre, destroys the leaves and greatly retards subsequent growth. Heavy applications of oil finally sterilize the ground, but they make the spot unsightly and create a fire hazard.

Sodium arsenite, which for many years was the most powerful plant poison known, also is fairly effective against quack grass when sprayed on the leaves at the rate of 3 pounds of sodium arsenite in 10 gallons of water to a square rod. The same solution poured into the soil of a trench 10 inches deep forms a barrier to prevent quack-grass roots from spreading into uninfested soil. However, sodium arsenite is violently poisonous to animals and man, and it must be used with extreme caution to prevent accidents.

Experiments are in progress with a new weed-killing chemical, sodium chlorate. A spray solution of 1 pound of sodium chlorate in 1 gallon of water, applied to a square rod of infested soil, is said to have a more lasting effect on quack grass than any other chemical. It is reported that two applications have completely destroyed the weed. Unfortunately, sodium chlorate is explosive or highly combustible when mixed with finely divided organic matter and is likely to make the sprayed vegetation, as well as the clothing, barrels, and other equipment of the operator, violently inflammable when dry. In handling and using chlorates, therefore, stringent precautions must be taken to protect workmen and property from fire.[3] Preparations containing calcium chlorate are being tested, along with other chlorates, but the comparative danger involved in using the several different chlorates is not yet fully known.

[3] A full statement of these precautions will be sent to any applicant.

Common salt and such chemicals as iron sulphate, copper sulphate, dilute acids, and coal-tar derivatives are practically valueless against quack grass.

MISCELLANEOUS METHODS OF CONTROL

HAND DIGGING

Usually the most convenient way to destroy a very small area of quack grass is to dig it out by hand. The work must be done thoroughly, however, for any small piece of rootstock left in the soil may renew the weed. Simply cutting off the leaves of the grass and digging out as many of the rootstocks as can be reached conveniently

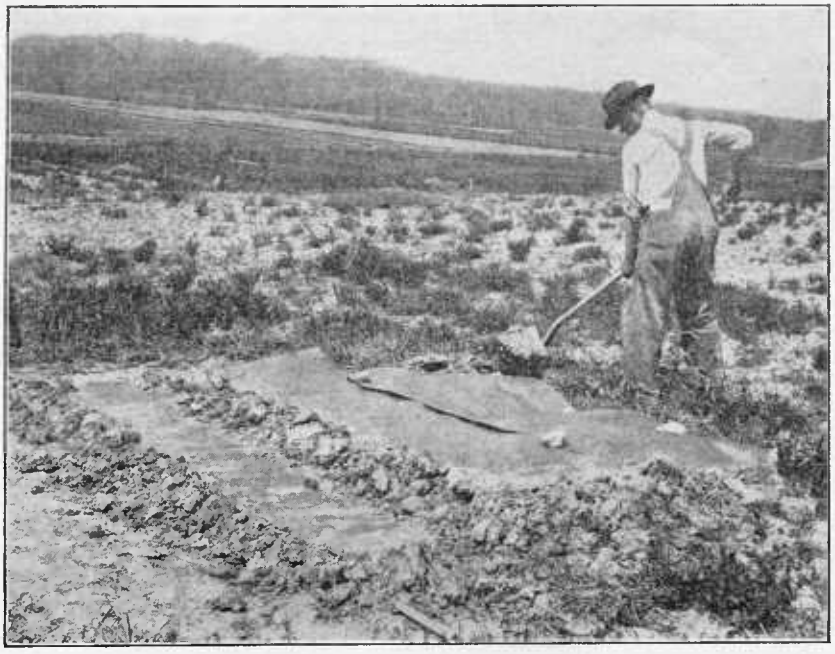

FIGURE 13.—Small patches of quack grass can be killed by covering them with tar paper for three or four months

with a hoe is not enough. The entire area must be carefully dug over to the depth of the lowest rootstock and each piece removed by hand or by sifting. A convenient way is to throw all the soil into a pile outside the area, throwing it back again as the rootstocks are removed. The treated area should extend at least a foot beyond the borders of the quack grass in order to get all the rootstocks. The best season for digging is from June 15 to July 15.

SMOTHERING WITH TAR PAPER AND OTHER MATERIALS

A less laborious but slower method of destroying small patches is to cover them from May until September with tar paper, straw, manure, old tin roofing, boards, or any other material that will totally exclude the light. The tar paper should be of a heavy grade and laid so as to overlap about 3 inches, and the laps should be

weighted with earth to make a tight joint and prevent the paper from blowing away. (Fig. 13.) Straw must be piled 3 feet thick and manure at least 1 foot thick to keep the grass from growing through. All coverings should extend 2 feet or more beyond the limits of the patch.

PASTURING WITH HOGS

As hogs are very fond of fresh quack-grass rootstocks, they are often turned into a field that is being plowed. It is possible to reduce quack grass greatly with hogs by withholding other feed except that needed to maintain the animals in strong condition; this limited amount of feed should be given in the evening. Plenty of water and shade should be provided. The hogs can not be expected to gain while on quack-grass pasture, but this loss may be offset by the destruction of the weed. Hogs that are strong rooters, such as Tamworths, are best, and their noses, of course, should not be ringed. Six hogs will remove a large percentage of rootstocks from an acre in a month. Sheep also will pick up many quack-grass rootstocks.

SPECIAL MACHINERY

A number of special machines have been devised for killing quack grass, most of them being designed to dig out the rootstocks and separate them from the soil, somewhat after the fashion of an elevator potato digger. Several of the machines have been satisfactory mechanically, but are too expensive for general use. As a rule, such machines do not destroy the weed completely, although they make it easier to kill the grass by cultivation and shading.

PRECAUTIONS NECESSARY TO KEEP QUACK GRASS OFF THE FARM

Prevention is always better than cure. While it is not always possible to keep quack grass from the farm there are certain precautions that should never be overlooked.

USE GOOD SEED

Quack grass is most commonly brought onto the farm in grass and grain seed. Oats, barley, bromegrass, and slender wheatgrass are the most usual carriers of the weed, although wheat and rye, if not well cleaned, may bring it. In wheat and rye the quack-grass seed is likely to be hulled, in which condition it closely resembles the rye. European bromegrass seed has been an especially prominent carrier of quack-grass seed in the Northwestern States. American-grown seed, however, is not always free from the weed. The smaller field seeds, such as timothy and the clovers, if properly cleaned, rarely contain quack-grass seed.

BE CAREFUL ABOUT HAY AND STRAW

Any hay or straw harvested after July 1 is likely to carry quack-grass seeds as well as pieces of the rootstocks picked up in raking. The rootstocks are not dangerous if thoroughly dried, but some at the bottom of the stack usually remain moist. Very frequently the appearance of quack grass around an old straw pile is traceable to

the thrashing machine, which brought in the weed seeds hidden in crevices under the shakers and in the tailings spout. Hay balers are also frequent offenders in this respect. Do not hesitate to clean these machines thoroughly with a broom before they are permitted to drive onto the farm. Any local law on the subject should be enforced.

DO NOT SPREAD INFESTED MANURE ON GRASSLAND

Manure that is thought to contain quack-grass seeds should be piled until well rotted or spread on land that is to be cultivated within three weeks. The young seedlings do not develop rootstocks until they are 4 or 5 weeks old, and can be destroyed as easily as other seedlings before that time. Infested manure should never be used for top-dressing pastures or meadows, as there is no way to kill the young seedlings without destroying the pasture or meadow. Quack-grass seeds usually get into manure through the bedding, although they may come from the hay or grain fed to horses, as the seeds are not always killed by the process of digestion.

DESTROY THE FIRST SMALL PATCHES

When quack grass first appears on a farm it should be totally exterminated, regardless of trouble or expense. Cost is no consideration in destroying a small patch of the weed. The area should be marked with stakes and the weed destroyed utterly. Repeated digging and removal of the rootstocks is satisfactory, but covering the patches with tar paper is more certain. The particular method is of little consequence; the object is to kill the weed before it can gather headway.

WATCH THE HARROW AND CULTIVATOR

Careful cultivation is very important. If necessary to cultivate through a patch of quack grass, lift the implement when crossing it, or at least clean the teeth thoroughly after passing. A few minutes spent at this point may mean the eventual saving of hours.

COLLECT AND BURN THE ROOTSTOCKS

When piles of rootstocks have been collected in the field by the harrow or cultivator, cart them to some out-of-the-way place and burn them. The temptation is to dump them in the road or along the streams or fences. From such places they are easily carried to adjoining land and may cause much ill feeling in the neighborhood.

DO NOT LET QUACK GRASS GO TO SEED

The wisdom of preventing quack grass from going to seed by cutting it when in full bloom seems too obvious to need discussion. Unfortunately, the blooming period comes just when other farm work is very pressing and few farmers care to take the time to cut weeds. Because of the dangerous nature of quack grass, it pays to cut it when necessary, even if other work must be neglected for a few

hours. As quack-grass seeds can grow before they are fully ripe, the weed should be cut before the seeds are hard.

UTILIZATION OF QUACK GRASS

Although quack grass is known chiefly for its bad habits as a weed it is by no means entirely worthless. When cut early it makes hay equal to timothy and is perhaps a better hot-weather pasture plant than any other crop except sweetclover. In several other ways quack grass has been found useful; and its utilization should not be despised or neglected simply because the plant is a weed.

It is not necessary, of course, that quack grass be planted purposely or that it be used in any way that could possibly cause harm. Several cases are known where the grass has been introduced into new territory as a promising forage crop, with results disastrous to the neighborhood. Planting quack grass, for forage purposes at least, is entirely unnecessary, as there are always other plants that answer the purpose quite as well and are much less difficult to control. Similarly, the practice of selling quack-grass hay should be strongly condemned, as the hay is almost certain to contain viable seeds.

Where quack grass already occurs in abundance, however, and there is little possibility of it injuring other persons, there is no reason why it should not be used; indeed, there are many times when it would be more profitable to utilize the plant than to try to keep it under control. Consequently, before undertaking an expensive program of eradication, weigh carefully the value of the cultivated crop that might be raised, the cost of raising it, and the value of the quack-grass hay and pasturage.

USE AS HAY

Most weedy grasses are tough, unpalatable, or otherwise undesirable for forage. Quack grass possesses nearly all the qualities desired in a hay plant, being palatable, nutritious, prolific, hardy, leafy, easily harvested, and adapted to wide variations of soil and climate. Were it not for the difficulty of controlling the grass in rotation areas, it might well have become one of the standard forage grasses of North America.

Although rarely cultivated, quack grass is an important element in commercial hays in nearly all of the large eastern hay markets. Probably 50 per cent or more of the timothy and mixed hays which enter the Boston market contain from 5 to nearly 100 per cent of quack grass. Similar conditions are found in the markets of New York, Philadelphia, and Buffalo, the percentage of admixture being largest in the hays from the Eastern States and scarcely noticeable in the better grades of timothy hay from the Middle West. Apparently, dealers do not discriminate against timothy containing quack grass except to grade the product as mixed hay. Cattle, horses, and sheep will eat a mixture of quack grass and other grasses without showing any preference, but all animals will reject the grass if it is cut so late that the dried stems are hard and tough.

Chemical analyses of quack grass as compared with those of the standard hay grasses are presented in Table 1.

TABLE 1.—*Chemical analyses of quack grass compared with other grasses*[1]

Forage grass	Chemical composition							Digestible nutrients in 100 pounds		Nutritive ratio
	Water	Ash	Protein	Crude fiber	Carbohydrates	Fat	Total dry matter	Protein	Carbohydrate equivalents	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Pounds*	*Pounds*	
Quack grass	12.5	6.6	9.3	23.0	45.8	2.8	87.5	5.4	48.1	8.9
Timothy	12.5	5.4	6.8	28.3	44.3	2.7	87.5	3.3	44.7	13.5
Redtop	8.9	5.2	7.9	28.6	47.5	1.9	91.1	4.8	49.1	10.2
Orchard grass	9.9	6.0	8.1	32.4	41.0	2.6	90.1	4.9	45.5	9.3
Oatgrass	8.1	6.4	9.4	29.8	43.6	2.7	91.9	4.1	43.2	10.5
Oat hay	11.0	6.8	7.9	29.6	41.9	2.8	89.0	4.2	41.7	9.9
Western bromegrass	5.8	8.4	8.4	32.2	42.9	2.3	94.2	4.3	48.3	11.2
Johnson grass	9.0	7.0	8.2	29.7	43.4	2.7	91.0	3.6	47.0	13.0
Crabgrass	9.0	8.2	7.0	30.1	43.3	2.4	91.0	4.1	50.4	12.3

[1] Analyses by the Bureau of Chemistry and Soils, U. S. Department of Agriculture.

Quack grass should be harvested for hay not later than the early blossoming stage, ordinarily about 10 days before it is time to cut timothy. Early cutting eliminates the danger of harvesting viable quack-grass seeds and ergot. The yield of the quack-grass hay from a new meadow is from 1 to 2 tons to the acre, approximately the same as that of an ordinary timothy meadow. In the region south of the Great Lakes a second or even a third cutting can be harvested during wet seasons.

Quack-grass meadows are unusually free from weeds, owing to the vigorous growth of the grass and to the fact that it is cut early, before weeds have a chance to go to seed. Such common meadow weeds as oxeye daisy, wild carrot, and fleabane are seldom associated with quack grass.

One disadvantage of quack grass from the standpoint of hay production is the fact that it becomes root bound. As the plant becomes root bound the yield falls off rapidly, usually decreasing from a quarter to a half the second year and almost disappearing by the third or fourth year. The meadow may be restored to maximum production, however, by stirring the sod vigorously in the spring by means of shallow plowing, thorough double-disking, or harrowing with a spring-tooth harrow. The matted rootstocks are thus torn to pieces and stimulated to produce a vigorous growth of leaves, so that in a few weeks the grass is in as thrifty a condition as ever. When handled in this way a quack-grass meadow may be maintained almost indefinitely without the expense of the periodic reseeding necessary with other grasses. Like all other grasses, quack grass responds to the use of fertilizer, and often a yearly top-dressing of barnyard manure or a light application of sodium nitrate, sulphate of ammonia, or other nitrogenous material is profitable. On some soils it pays to use phosphate fertilizers.

Mixtures of quack grass and other grasses are more common and more desirable than quack grass alone. Although a sod grass, quack grass often grows in irregular patches rather than in solid stands, and it is well to have other grasses to fill the bare spots in the field. Orchard grass is especially well suited for mixing with quack grass,

as the two mature about the same time. Perennial ryegrass, tall meadow oatgrass, and meadow fescue also do well as companion crops. The plants most commonly associated with quack grass are timothy, red clover, alsike clover, and redtop. Alfalfa and quack grass make a very good mixed hay, although the quack grass tends to run out the alfalfa in two or three years if the seed bed is not free from the grass at the time the alfalfa is planted.

One way of handling quack-grass land is to sow the field to sweetclover, which by its rank growth forces the quack grass to grow taller, while the grass lightens the clover hay, making it more easily cured and adding somewhat to its palatability. To prepare for the sweetclover, the quack grass is double disked early in the spring and seeded immediately with 12 to 15 pounds an acre of hulled and scarified sweetclover seed. The seed is sown broadcast and covered by rolling rather than harrowing. One cutting of quack grass and one of mixed grass and clover are obtained the first year, and two cuttings of mixed hay the second. The yield of each cutting averages about 2 tons an acre on good land, which is more than either crop would yield alone. Since sweetclover is a biennial plant, it fits in very well with the rejuvenation process required for quack grass.

USE FOR PASTURAGE

Quack grass is not as abundant in pastures as in meadows, owing to its tendency to become sod bound and disappear, but where it occurs it is a good grazing grass. It starts growth earlier in the spring than bluegrass or redtop and continues to furnish green pasture until late in the fall. It withstands hot, dry weather as well as bluegrass or better and makes more growth on sandy soils or soils poor in lime. A good sod of quack grass endures close grazing by cattle, although sheep sometimes injure it by too close nibbling.

A quack-grass sod must be rejuvenated every two or three years. If other grasses predominate in the pasture, however, it usually is not advisable to disturb the sod simply for the sake of encouraging the quack grass. As quack grass when fully matured is not eaten by livestock, the area should be closely pastured or kept closely mowed to induce the development of new leaves.

A rather unusual form of pasturage is furnished by the rootstocks, which are sweet, succulent, nutritious, and relished by hogs and sheep. The animals may be turned on a newly plowed field to graze, or the rootstocks may be raked off and fed like hay. During the latter half of the season the rootstocks often contain more nutriment than the aboveground portions of the plant. In Europe the rootstocks are fed to animals instead of being burned or thrown away. Some caution should be used in feeding the rootstocks, as they have a diuretic effect and may be harmful if fed in excess.

USE AS SILAGE

Almost any combination of quack grass and a leguminous forage crop can be used successfully as silage. Often a field of mammoth clover which has become infested with quack grass can be saved by putting the crop into the silo when it is too old and hard to make good hay. The quality and keeping properties of pea waste from

canneries, which is often used for ensilage, are improved by the presence of quack grass. Quack grass does not make good silage by itself unless cut while very green, since the mature crop is not sufficiently succulent. One advantage of ensiling quack grass is that the seeds are killed in the process.

USE IN LAWNS

As would naturally be expected, much quack grass finds its way into lawns in the quack-grass regions. A closely mowed quack-grass sod makes a dense turf, somewhat coarser than that of blue-grass or the bentgrasses, but finer than that of crabgrass or timothy. The herbage is of a pleasing dark-green shade that retains its color from early spring until late fall. In parts of New England and the Middle Western States quack grass is one of the most useful of lawn grasses, and a careful examination of the most attractive lawns often discloses a high percentage of this species. On sandy soils in Michigan it has been the most successful turf grass for golf courses and other much-used surfaces.

USE IN ROTATIONS

Because of the fact that quack grass must be plowed occasionally to maintain the vigor of the sod, it can be worked in with short rotations to good advantage. One of the best of these rotations is quack grass and buckwheat. When the sod shows signs of deterioration, the field can be plowed shallow and harrowed once, immediately after haying. Except in the extreme northern part of its range, buckwheat can then be planted in time to produce a crop before frost. The buckwheat should not be planted thick enough to injure the grass by shading, 3 pecks of seed to the acre being sufficient. Some growers make a practice of seeding from 4 to 6 pounds of perennial ryegrass or tall oatgrass with the buckwheat in order to insure a good meadow, the quack grass, of course, taking care of itself.

Quack grass is also grown in rotation with fodder corn, the sod being plowed shallow in the fall and left rough over winter, so that the grass will not smother the corn in the spring. Almost any crop that makes a quick, rank growth can be grown in rotation with quack grass, provided it does not occupy the land for more than three or four months.

USE AS A SOIL BINDER

The tough interlacing rootstocks of quack grass are very useful for holding the soil on railroad embankments, terraces, gullies, river banks, and hillsides that tend to wash. The plants are readily propagated either from seed or from cuttings of the rootstocks, the cuttings being preferred, because the young plants thus become firmly rooted more quickly. Both seeds and rootstocks are best planted in early spring in shallow trenches dug about 1 foot apart across the face of the slope.

USE IN MEDICINE

The prepared rootstocks of quack grass are used in the drug trade, usually under the name of dog grass, or Triticum. The available

supply of quack grass, however, exceeds any possible demand, and the market could easily be overloaded. Doubtless a limited opportunity will remain for persons to gather and sell the rootstocks, but the current demand should be determined before engaging in the business.

USE AS FOOD

Both the seeds and rootstocks of quack grass have been used in times of emergency for food. The seeds yield a fair quality of flour, similar in appearance to rye flour. When gathered in the spring or fall the rootstocks can be ground into flour, which produces a rather heavy, light-colored bread. During the World War this material was used in southern Bavaria, where it was declared superior to most wheat substitutes. Neither the seed flour nor the rootstock flour is of the highest quality, and its preparation is somewhat laborious, but it is nutritious and not unpalatable.

Decoctions or teas made from the dried rootstocks are well known in central Europe, where they are thought to have a slight nutritive as well as medicinal value. A coffee substitute also has been prepared from the roasted rootstocks. Attempts to utilize the rootstocks in the production of commercial alcohols and sugars and as a substitute for barley in malting have not proved successful.

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